Mars Environmental Compatibility Assessment (MECA) - Identifying the Hazards of the Martian Soil

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Sometime in the next decade NASA will decide whether to send a human expedition to explore the planet Mars. The Mars Environmental Compatibility Assessment (MECA) has been selected by NASA to evaluate the Martian environment for soil and dust hazards to human exploration. The integrated MECA payload contains three elements: a wet-chemistry laboratory, a microscopy station, and enhancements to a lander robot-arm system incorporating arrays of material patches and an electrometer to identify triboelectric charging during soil excavation.

The wet-chemistry laboratory will evaluate samples of Martian soil in water to determine the total dissolved solids, redox potential, pH, and quantify the concentration of many soluble ions using ion-selective electrodes. These electrodes can detect potentially dangerous heavy metal ions, emitted pathogenic gases, and the soil's corrosive potential.

MECA's microscopy station combines optical and atomic-force microscopy with a robot-arm camera to provide imaging over nine orders of magnitude, from meters to nanometers. Through a careful selection of sample receptacles and an abrasion tool, particle size, shape, angularity, fibrosity, adhesion, hardness, and other properties will be determined on the microscope stage. The simple, rugged atomic-force microscope will image in the submicron size range and has the capability of performing a particle-by-particle analysis of the dust and soil.

Although selected by NASA's Human Exploration and Development of Space Enterprise, the MECA instrument suite also has the capability of addressing the possibilities of life on Mars past as well as future. Rehydrating the Martian soil in the wet-chemistry laboratory will reproduce the conditions believed to pertain to an earlier, wetter Mars. On Earth, the earliest forms of life are preserved as microfossils. The atomic-force microscope will have the required resolution to image down to the scale of terrestrial microfossils and beyond.

The research described in this presenation was carried out by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.